STATE OF NEW YORK
MALCOLM WILSON, Governor
DEPARTMENT OF TRANSPORTATION
RAYMOND T. SCHULER, Commissioner
1220 WASHINGTON AVE., STATE CAMPUS, ALBANY, NEW YORK 12226

EVALUATION OF PENETRATING CONCRETE SEALING COMPOUNDS FOR USE AS BRIDGE DECK PROTECTIVE SYSTEMS

INTERIM REPORT

PHASE I

BRIDGE DECK CONSTRUCTION

materials bureau technical services subdivision

MEMORANDUM

DEPARTMENT OF TRANSPORTATION

DATE November 14, 1974

SUBJECT CONTROLLED TESTING OF BRIDGE DECK SEALANTS
NEEP PROJECT NO. 12, CATEGORY 2 EXPERIMENTAL FEATURE

FROM H. H. McLean, Materials Bureau, Room 210, Bldg. 7A

TO V. E. Taylor, Federal Highway Administration, 01-30.2

We are sending you six copies of our report "Evaluation of Penetrating Concrete Sealing Compounds for use as Bridge Deck Protective Systems; Interim Report, Phase I, Bridge Deck Construction." This evaluation has been approved as a Category 2 Experimental Feature and is being performed in conjunction with the National Experimental and Evaluation Program (NEEP) project No. 12 - Bridge Deck Protective Systems. The report describes the deck construction operations and protective system applications on a bridge on Interstate 88 near Oneonta.

This is the first in a series of reports that will give an in-service evaluation of four penetrating concrete sealing compounds. Later reports will document laboratory analysis of field samples and field measurements and observations. This report follows procedures listed in the project working plan that we sent to your office by memorandum on May 9, 1973.

HHM:RC:js
File: ES-9
M931,842
Attachments

EVALUATION OF PENETRATING CONCRETE SEALING COMPOUNDS FOR USE AS BRIDGE DECK PROTECTIVE SYSTEMS

INTERIM REPORT

PHASE I - BRIDGE DECK CONSTRUCTION

Joseph H. Sanders
Junior Engineer
John P. Ublacker
Principal Engineering Materials Technician

New York State Department of Transportation
Technical Services Subdivision
Materials Bureau
Harry H. McLean, Director

I. Introduction

The Materials Bureau of the New York State Department of Transportation is conducting an in-service evaluation of several penetrating concrete sealing compounds employed as bridge deck protective systems. This study is in conjunction with the National Experimental and Evaluation Program (NEEP) Project Number 12, "Bridge Deck Protective Systems." It follows to the extent possible the Federal Highway Administration notice of April 22, 1971 for that project.

This initial report is intended to furnish necessary documentation regarding the construction details of this project. Later reports will provide laboratory analysis of bridge deck cores, field measurements of deck half-cell potentials and field observations of deck performance.

II. Materials Tested

Four penetrating concrete sealing treatments are being tested. A list of the treatments follows with the product name, its time of application during the finishing process and its approximate per gallon cost. (Costs are quoted from the vendor who supplied all the compounds for this project and are stock prices for small quantities.)

1. Linseed Oil Protective Coating for Concrete, N.Y.S. D.O.T. Special Specifications Item No. 664LD. (Applied to the cured concrete surface: $3.20/gal.)
2. Aquadron, a product of Dural International Corporation. (Applied to the cured concrete surface: $17.50/gal.)
3. Deepgard Curing and Protective Compound, a product of Contech, Inc.; formerly a product of PPG Industries. (Applied to the concrete surface immediately after the finishing operation: $3.20/gal.)
4. Seal Cure, a product of Cement Materials. (Applied to the surface immediately after the finishing operation: $5.00/gal.)

For comparison purposes there are control sections of untreated concrete, cured with White-Pigmented Membrane Curing Compound, N.Y.S.D.O.T. Specification Item M40C. The compound was applied to the concrete surface immediately after the finishing operation. The materials cost was $1.25/gal.

All materials received approximately the same application rate for each coat applied, 200-250 sq.ft./gal. Both the Linseed Oil and Aquadron required two coats of treatment while the others received only one coat. White-Pigmented

Curing Compound was applied to the untreated control sections and to those areas receiving Linseed Oil and Aquadron. The sections receiving Linseed Oil and Aquadron were sandblasted to remove as much White-Pigmented Curing Compound as possible before treatment with these agents. This occurred no earlier than 28 days after the finishing operation was completed. Deepgard and Seal Cure are self-contained curative and protective treatments and require no White-Pigmented Curing Compound application prior to their use.

III. Test Site

The project location is Bridge No. 3 on New York State Department of Transportation Contract No. FISH 71-6, Interstate Route 88, Oneonta: East Oneonta City Line to County Road 47. This project, located in Otsego County, is Federal Aid Project Number I-IG-88-1(4). Its NYSDOT Project Identification Number is 9357.19.312.

Bridge No. 3 carries I-88 over the Delaware and Hudson Railroad just north of the city of Oneonta. The bridge is, in fact, two identical three-span composite beam structures, one carrying eastbound traffic and the other westbound. Two

of the three spans are 120'-2" long and the third is 93'-3". Both structures are built on a 60° skew.

IV. Deck Construction Data

A. Concrete Mix Design.

The concrete mix design for 1 cubic yard of concrete in the bridge deck was:

780 Lbs	#2 Stone,	specific gravity = 2.70
970 lbs.	#1 Stone,	specific gravity = 2.70
1200 lbs.	Sand,	specific gravity = 2.63
611 lbs.	Cement	
33 gal.	Water plus retarder.	

Stone aggregate was supplied by General Crushed Stone of Jordanville, N.Y. and the sand by Special Aggregate Corporation of Poland, N.Y. Concrete was supplied by Otsego Ready Mix of Oneonta, N.Y.

B. Construction Equipment & Construction Details.

Concrete was pumped into place on the deck from beneath the structure. A CASE P-336 Turbo Placer Pump was used. Before each morning's pumping operations were started one cubic yard of grout was used to lubricate the pump system. The grout was then discarded.

Finishing operations were accomplished with a GOMACO finishing machine. Finishing work was done moving with the structures'

60° skew, requiring a screed over 88 feet long and weighing approximately two tons. Each night before a concrete pour the screed went through a trial run. A corrugated metal Havilla Float was used to produce desired surface texture.

V. Application of Surface Treatments

A. Application Scheme.

The concrete sealing treatments were applied in sections twelve feet wide and running parallel with the skew of the structure. Each span was divided into as many twelve foot sections as its length would accommodate. Odd lengths remaining were either added to the final test section or made a separate test section. In either case the odd length test sections are closest to the west abutment. Two samples of each of the four concrete sealing compounds and two control sections are on the 120'-2" slabs. Eight test sections are on the 93'-3" slabs, two samples each of three treatments and one sample of each of the remaining two treatments. Placement locations for each treatment were determined by statistical random sampling techniques. Figures I, II and III show the application schemes for both structures.

Twelve-foot test sections were measured off and labeled on wooden curb forms starting from the east end of each span. Nails were driven into the forms at these points to accommodate a string line drawn from curb to curb to guide the spraying of treatment applications during finishing operations. The string lines helped to minimize the amount of contamination from one test section to another.

Hand compressor-sprayers were used to apply the surface treatment compounds from a workbridge following the finishing screed. Enough material to cover a test section area was premeasured into the apparatus and applied uniformly over the concrete surface. Application was started when the screed moved far enough ahead to complete an entire test section from the workbridge. Since the test site was windy much of the time, care had to be exercised by workmen doing the spraying in order to minimize section overlap. A representative of the Materials Bureau was present throughout all construction operations to assure that work was performed to project specifications.

VI. Daily Progress Log

May 10, 1973 - Construction of Slab 2E

Construction of this slab was begun and completed. The air temperature measured at the bridge deck averaged 72°F in the a.m. and 78°F in the p.m. The relative humidity, measured with a sling phychometer, varied from 59% in the a.m. to 41% in the p.m. Wind was moderate throughout the entire construction operation with cloudy, bright sunshine.

A total of 144 cubic yards of concrete was placed by pumping. The air content, measured using a Washington Air Pot, varied from a low of 5.9% to a high of 7.4% with an average value of 6.3%. The concrete temperature averaged 71°F. The average slump of the concrete was 3.1 inches. A retarder was used in the morning but by mid-afternoon it was eliminated from the mix. For all subsequent construction the retarder was considered unnecessary.

After the slab was completed, polyethylene sheeting was placed over the fresh finished concrete. This was done because threatening skies and lightning were observed nearby. A thundershower with driving rain did occur around 6:00 p.m. Some concrete was damaged with small impressions by wooden planks holding down the curing blankets in the

wind. Sections of the slab were later ground down and refinished with epoxy-mortar to repair this damage.

May 11, 1973 - Construction of Slab 1E

Construction of this slab was begun and completed. The air temperature averaged 68°F in the a.m. and 64°F in the p.m. The relative humidity was 49% at noon. Cloudy, bright sunshine in the morning changed to a heavy overcast by afternoon. There was a strong wind throughout the day.

A total of 118 cubic yards of concrete was placed by pumping 40 feet vertically from below the bridge deck on the southeast side of the slab. Concrete air content varied from a low of 5.4% to a high of 6.0% with an average value of 5.7%. The concrete temperature averaged 70°F. The average slump of the concrete was 3.0 inches.

A rain shower hit at mid-afternoon, with high winds and heavy precipitation for twenty minutes. Three test sections at the east end of the slab had to be refinished and recured. These were treatments of Deepgard, Seal Cure and untreated concrete with the white-pigmented curing compound.

May 14, 1973 - Construction of Slab 3E

On this day construction of the remaining slab on the eastbound structure was started and completed. The air

temperature was 56°F in the a.m. and rose to 58°F in the p.m. The relative humidity was 66% in the a.m. and 60% in the p.m. It was windy throughout the entire construction operation with overcast skies and some intermittent sunshine.

A total of 142 cubic yards of concrete was placed by pumping. The air content varied from a low of 6.0% to a high of 6.7% with an average of 6.4%. The concrete temperature averaged 63.5°F. The average slump of the concrete was 3.2 inches.

The main pump broke down early in the morning and a switch was made to a backup pump of the same type to finish the slab.

May 24, 1973 - Construction of Slab 3W

On this day construction of the first slab on the westbound structure began and was completed. The air temperature averaged 66°F in the a.m. and 72°F in the p.m. The relative humidity was 55% at noon. It was cloudy and moderately windy all day.

Approximately 80 cubic yards of concrete were placed using the Case Turbo Placer pump when it broke down. The standby pump was pressed into service but it plugged up.

immediately since no grout was run through it when the transfer was made. The rest of the slab was finished by lifting the concrete to placement with a crane. The transition was made smoothly, although about 25 cubic yards of concrete were lost when mixing trucks exceeded the 90 minute time limit on discharge.

A total of 142.5 cubic yards of concrete was placed. The air content varied from a low of 5.4% to a high of 7.0% with an average value of 5.9%. The concrete temperature averaged 71.4°F. The average slump of the concrete was 3.4 inches.

May 29, 1973 - Construction of Slab 2w

Work on this fifth slab began and was completed. The air temperature averaged about 70°F for the day. The relative humidity was 66% at noon. The wind was very strong throughout the construction operation with cloudy skies the entire day. At 6:00 p.m. the temperature dropped suddenly and a heavy rainstorm started around 7:30 p.m.

Concrete was pumped from beneath the deck over a vertical rise of 45 feet. A total of 140 cubic yards was placed. The air content varied from a low of 5.5% to a high of 6.2%, averaging 5.6%. The concrete temperature averaged 71.4°F.

The average slump of the concrete was 3.4 inches.

There was enough time to prepare for the rainstorm at the end of the pour, and an inspection of the concrete [illegible].

May 30, 1973 - Construction of Slab 1W

Construction of the last slab on Bridge No. 3 was begun [illegible]. The air temperature average was 81°F for the a.m. and 78°F for the p.m. The relative humidity ranged from 50% in the a.m. to 58% in the p.m. Weather conditions were [illegible] with mostly sunny skies and calm throughout the day.

A total of 113 cubic yards of concrete was placed by pumping. The pumping was done vertically from approximately 40 feet below the bridge deck. Concrete air content varied from a low of 4.8% to a high of 6.4% with an average value of 5.7%. The concrete temperature averaged 72°F. The average slump of the concrete was 3.4 inches. This was easily the smoothest construction operation of all the slabs.

July 2 and 3, 1973 - Application of Linseed Oil and Aquadron Treatments to Eastbound Structure

Since these areas were covered with one coat of white-pigmented curing compound the coating was removed as completely as possible without damaging the finished slab surface. This allowed for maximum penetration of both the Linseed Oil and Aquadron treatments. The coating was removed by sandblasting, starting at the west end of the structure.

The sandblasting was very effective in removing the white-pigmented curing compound and should insure maximum penetration with these treatments. "Black beauty" blasting grit was used in the sandblasting operation.

Trouble was encountered with the spray apparatus on July 2 and treatments of Linseed Oil and Aquadron were rolled onto slab 1E instead of being sprayed. The same was also done for two test sections on slab 2E. The next day the spray apparatus was working again and the remaining treatments were applied. Both Linseed Oil and Aquadron applications require two coats and this was done according to the manufacturers' instructions.

[illegible] 30 and 31, 1973 - Application of Linseed oil and [illegible]

The sandblasting of this structure was not as thorough [illegible] Sandblasting on the [illegible] structure caused pitting of [illegible] finished concrete surface in several areas. To avoi[d] a reoccurrence the westbound bridge received a lighter sand-blast. This may affect the penetration of the sealing [illegible] enough white-pigmented curing compound had been removed to permit good penetration. "Black beauty" blasting grit was again used.

There was no malfunction of the spraying apparatus, and both treatments were sprayed on in two coats.

July 30 and 31, 1973 - Core Drill Operations

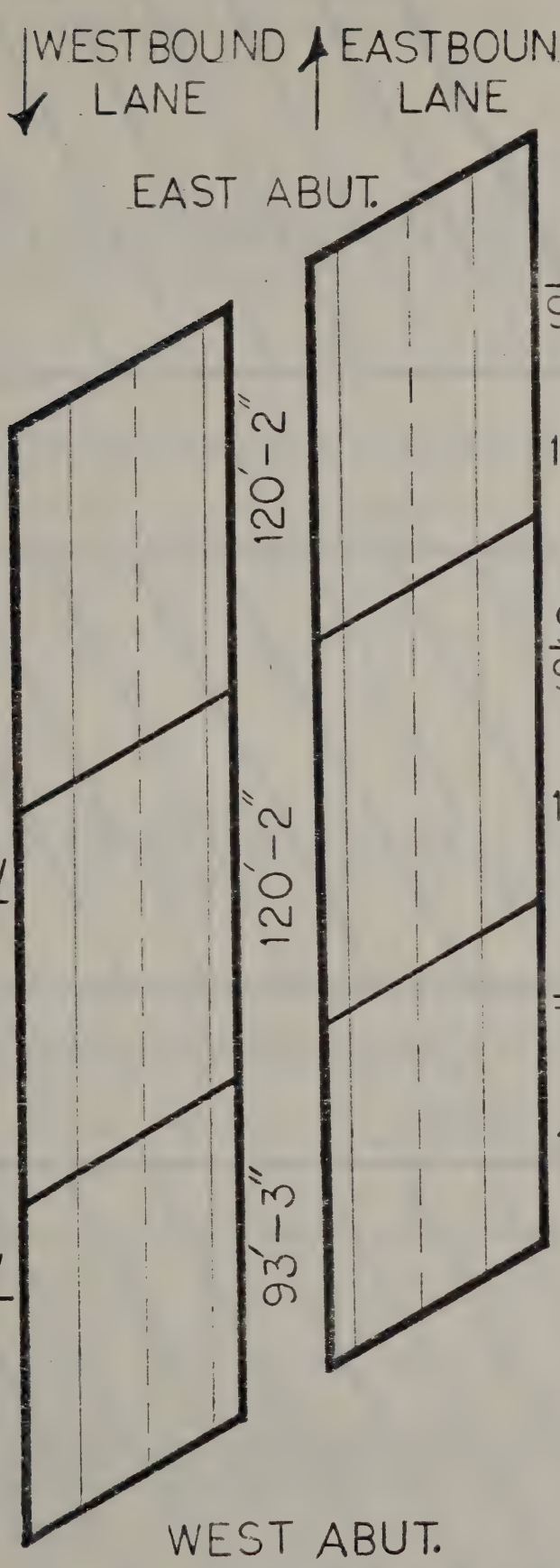
Cores were taken from both structures. Five cores were [illegible]

VIII. Acknowledgements

It should be noted here that good construction practices were followed in placing the bridge deck. With minor exceptions, the work proceeded smoothly with excellent cooperation, especially during the application of the experimental sealing compounds.

The Materials Bureau thanks those New York State Department of Transportaion personnel involved in this project for their help and cooperation. Our special thanks go to the project engineer-in-charge, Harold McFee, and to John Gross, Al Boone, Mickey Moore and Jim Vaughn.

FIGURE I



SLAB NO. 3W
(12' TREATMENT SECT.)
&
(12'-2" TREATMENT SECT.)

SLAB NO. 2W
(12' TREATMENT SECT.)
&
(12'-2" TREATMENT SECT.)

SLAB NO. 1W
(12' TREATMENT SECT.)
&
(9'-3" TREATMENT SECT.)

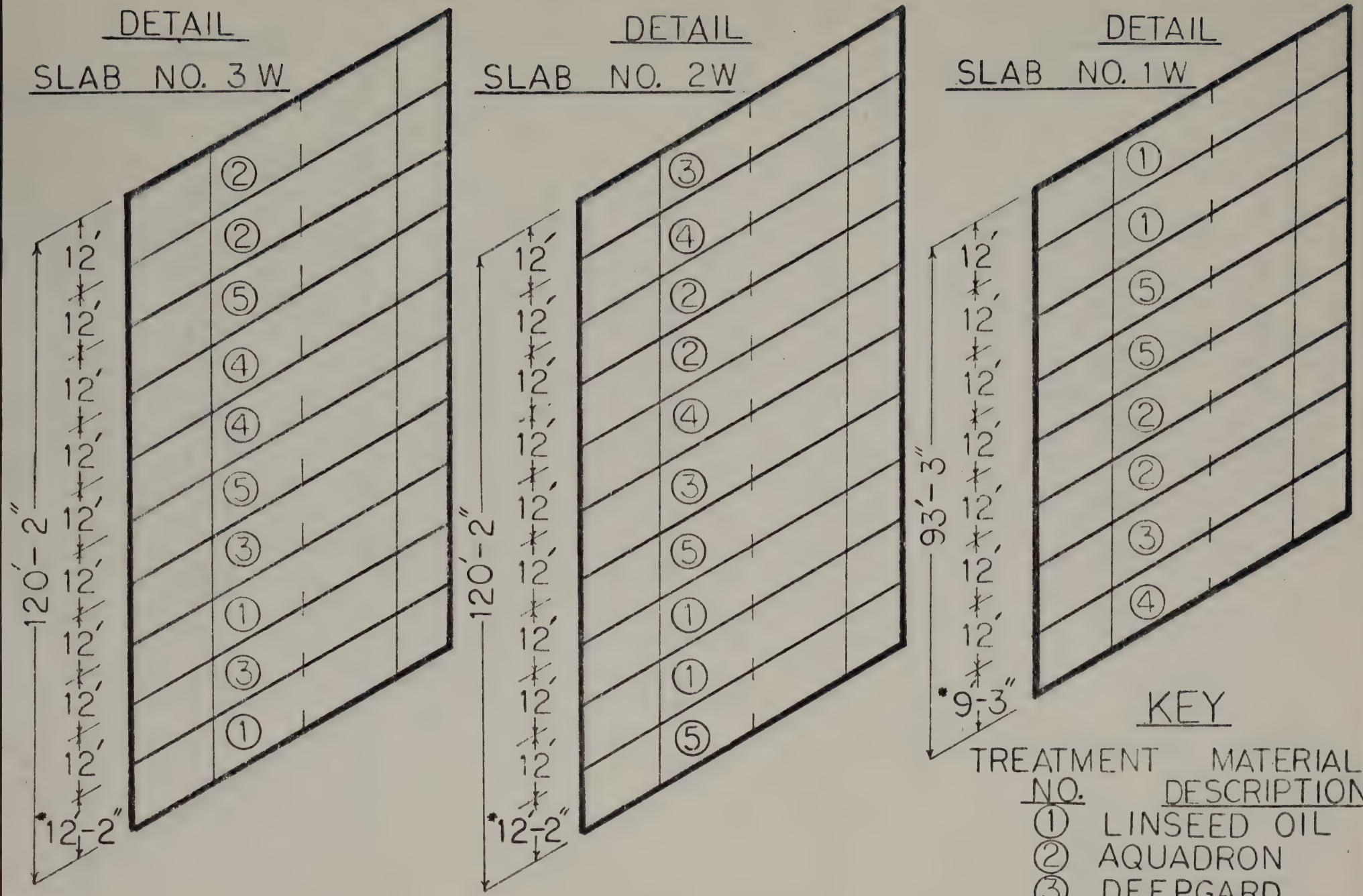
SLAB NO. 3E
9 (12' TREATMENT SECT.)
&
1 (12'-2" TREATMENT SECT.)

SLAB NO. 2E
9 (12' TREATMENT SECT.)
&
1 (12'-2" TREATMENT SECT.)

SLAB NO. 1E
7 (12' TREATMENT SECT.)
&
1 (9'-3" TREATMENT SECT.)

*NOTE ODD LENGTH SECT. SHOULD BE LOCATED AT WEST END OF SLAB.

FIGURE II


DETAIL
SLAB NO. 3W
120'-2"
12'
12'
12'
12'
12'
12'
12'
12'
12'
12'
12'
12'
*12-2"
② ② ⑤ ④ ④ ⑤ ③ ① ③ ①
DETAIL
SLAB NO. 2W
120'-2"
12'
12'
12'
12'
12'
12'
12'
12'
12'
12'
12'
12'
*12-2"
③ ④ ② ② ④ ③ ⑤ ① ① ⑤
DETAIL
SLAB NO. 1W
93'-3"
12'
12'
12'
12'
12'
12'
12'
12'
12'
*9-3"
① ① ⑤ ⑤ ② ② ② ③ ④
KEY
TREATMENT NO.
MATERIAL DESCRIPTION
① LINSEED OIL
② AQUADRON
③ DEEPGARD
④ SEAL CURE
⑤ UNTREATED CONC.

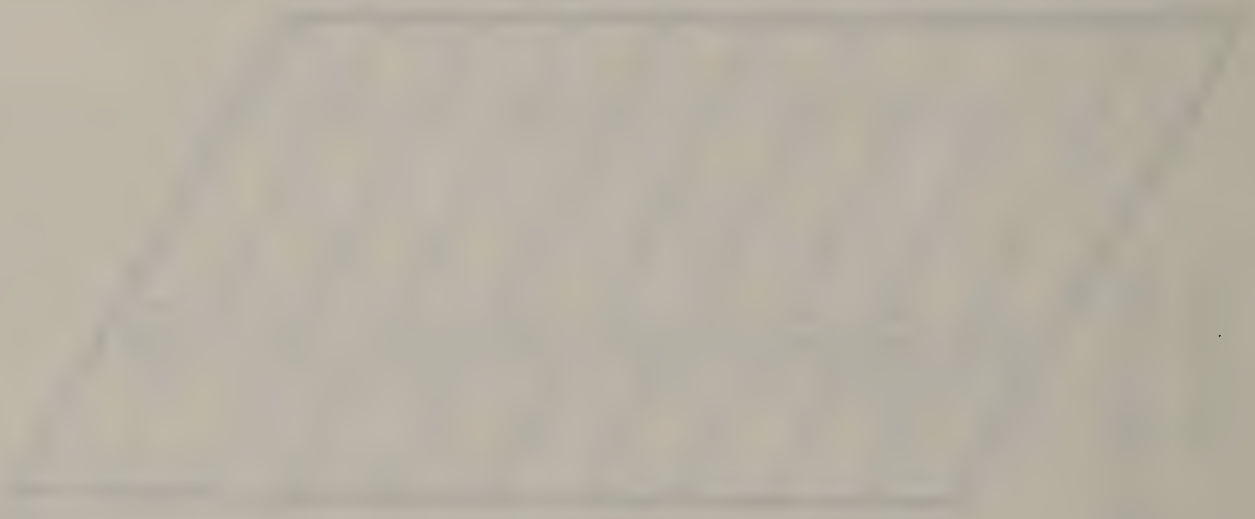
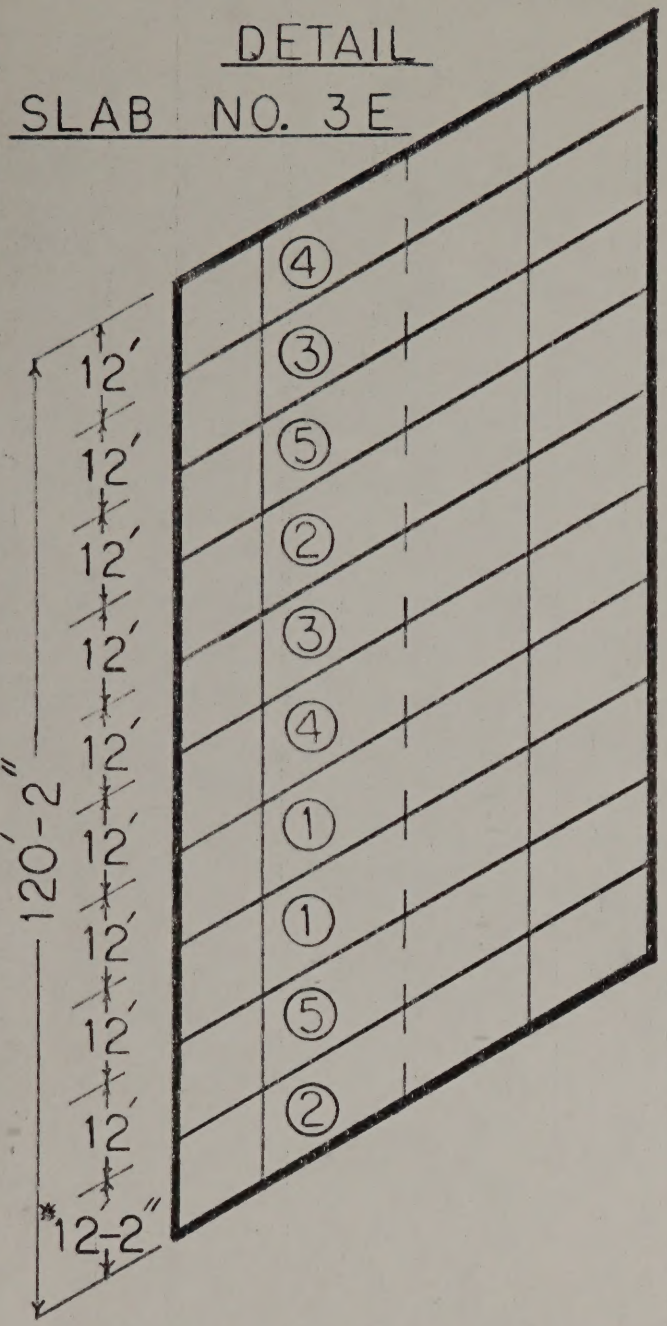
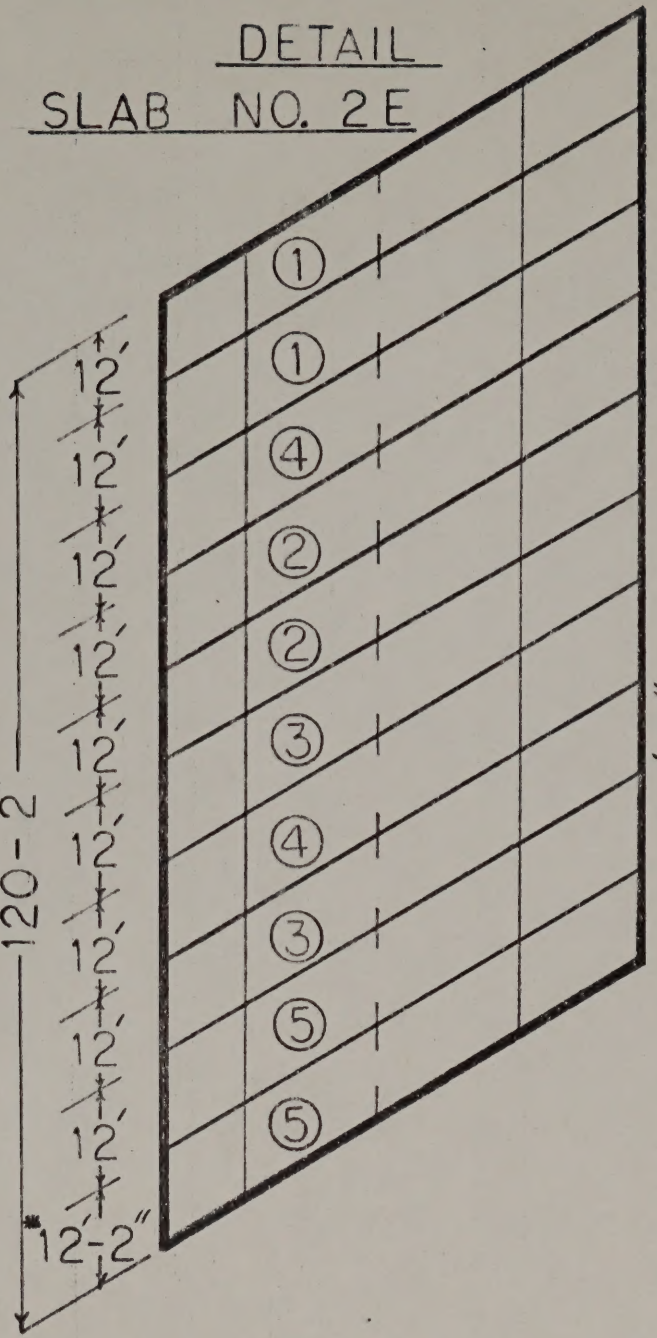


FIGURE II

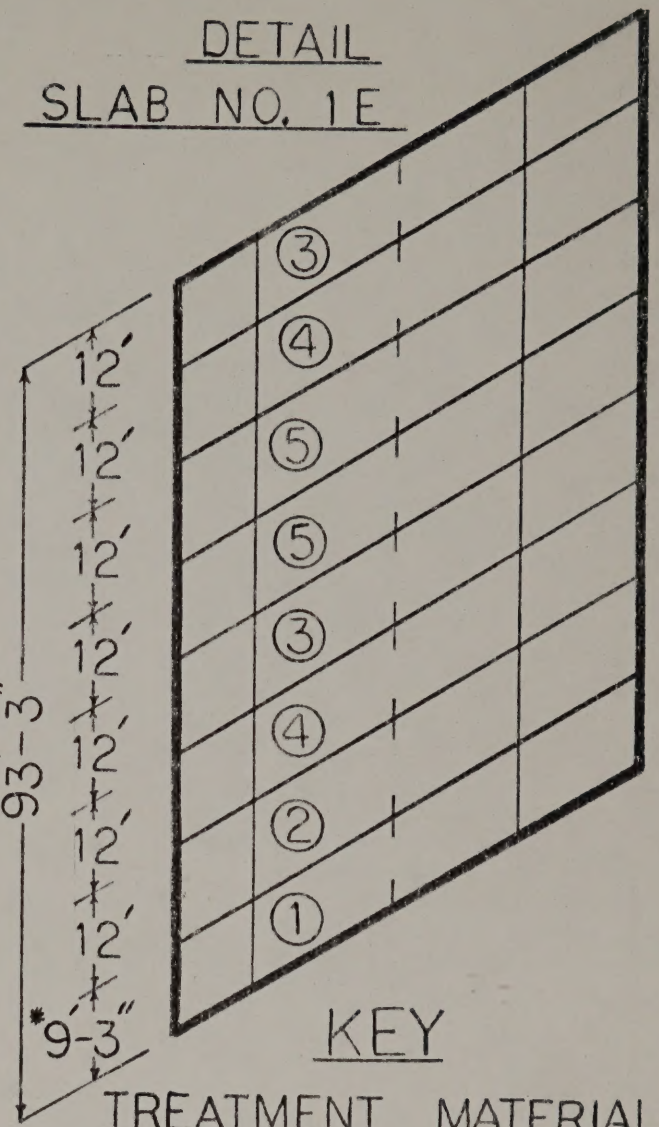
DETAIL
SLAB NO. 3E



DETAIL
SLAB NO. 2E



DETAIL
SLAB NO. 1E



KEY

TREATMENT MATERIAL

NO.	DESCRIPTION
①	LINSEED OIL
②	AQUADRON
③	DEEPGARD
④	SEAL CURE
⑤	UNTREATED CONC.